

CLAIMS

1 1. A process for the plasma deposition of a layer of
2 microcrystalline semiconductor material, wherein a process gas which includes
3 a precursor of the semiconductor material and a diluent is energized with
4 electromagnetic energy so as to create a plasma therefrom, which plasma
5 deposits a layer of said microcrystalline semiconductor material onto a
6 substrate, wherein the improvement comprises:

7 varying the concentration of the diluent in said process gas as a function
8 of the thickness of the layer of microcrystalline semiconductor material which
9 has been deposited.

1 2. The process of claim 1, wherein the concentration of said
2 diluent is decreased as the thickness of said layer increases.

1 3. The process of claim 1, wherein the concentration of said
2 diluent is varied in a stepwise manner as the thickness of said layer increases.

1 4. The process of claim 1, wherein the concentration of said
2 diluent is varied as a continuous function of the thickness of the layer.

1 5. The process of claim 1, wherein said microcrystalline
2 semiconductor material includes a group IV element.

1 6. The process of claim 1, wherein said process gas comprises a
2 member selected from the group consisting of: SiH₄, Si₂H₆, GeH₄, SiF₄, GeF₄
3 and combinations thereof.

1 7. The process of claim 1, wherein said diluent is selected from the
2 group consisting of hydrogen, deuterium, a halogen and combinations thereof.

1 8. The process of claim 4, wherein said diluent comprises
2 hydrogen.

1 9. The process of claim 1, wherein said electromagnetic energy is
2 microwave energy.

1 10. The process of claim 1, wherein said electromagnetic energy is
2 radiofrequency energy.

1 11. The method of claim 1, wherein the step of varying the
2 concentration of the diluent in the process gas comprises changing the amount
3 of the diluent in said process gas.

1 12. The method of claim 1, wherein the step of varying the
2 concentration of the diluent in the process gas comprises changing the amount
3 of the semiconductor precursor in the process gas.

1 13. The process of claim 1, including the further step of varying at
2 least one other deposition parameter as a function of the thickness of the layer
3 of microcrystalline semiconductor material which has been deposited, said
4 other deposition parameter being selected from the group consisting of:
5 process gas pressure, power density of said electromagnetic energy, frequency
6 of said electromagnetic energy, and substrate temperature.

1 14. The process of claim 1, wherein said semiconductor material
2 includes silicon and germanium therein and wherein said process gas includes a
3 silicon-containing compound, a germanium-containing compound, and a
4 diluent selected from the group consisting of hydrogen, deuterium and
5 combinations thereof, and wherein the ratio of said silicon-containing
6 compound to said germanium-containing compound is varied while said
7 semiconductor material is being deposited so that the silicon/germanium ratio
8 of said layer of semiconductor material varies as a function of layer thickness;
9 and wherein the concentration of said diluent gas in the process gas is increased
10 as the ratio of said germanium-containing compound to said silicon-containing
11 compound therein increases.

1 15. A method for the manufacture of an N-I-P type photovoltaic
2 device, said method comprising the steps of:
3 providing a substrate;

4 depositing a first, doped layer of a semiconductor material on said
5 substrate;

6 depositing a microcrystalline layer of a substantially intrinsic
7 semiconductor material upon said first doped layer by a plasma deposition
8 process wherein a process gas which includes a precursor of the substantially
9 intrinsic semiconductor material and a diluent is energized with
10 electromagnetic energy so as to create a plasma therefrom, which plasma
11 deposits said layer of microcrystalline, substantially intrinsic semiconductor
12 material; wherein the process includes the step of decreasing the concentration
13 of the diluent in the process gas as a function of the thickness of the layer of
14 microcrystalline, substantially intrinsic semiconductor material which has been
15 deposited; and

16 depositing a second doped layer, of a conductivity opposite that of said
17 first doped layer, atop said body of microcrystalline, substantially intrinsic
18 semiconductor alloy material.

1 16. The process of claim 15, wherein the microcrystalline,
2 substantially intrinsic semiconductor material includes a group IV element
3 therein.

1 17. The method of claim 16, wherein said group IV element is
2 selected from the group consisting of silicon, germanium, and combinations
3 thereof.

1 18. The method of claim 15, wherein said diluent is selected from
2 the group consisting of hydrogen, deuterium, a halogen and combinations
3 thereof.

1 19. The method of claim 18, wherein said diluent comprises
2 hydrogen.

1 20. The process of claim 15, wherein said electromagnetic energy is
2 microwave energy.

1 21. The method of claim 15, wherein said electromagnetic energy is
2 radiofrequency energy.